

Transport Canada for type certification of the Bombardier Model BD-100-1A10. On June 28, 1999, Transport Canada made application on behalf of Bombardier for type certification of the Model BD-100-1A10 by the FAA. The Bombardier Model BD-100-1A10 will be type certificated in Canada and in the United States. The Model BD-100-1A10 is a medium-sized transport category airplane, powered by two Allied Signal high bypass turbofan engines mounted on the aft fuselage. Each engine can deliver up to 6,500 pounds of thrust at takeoff. The airplane will be capable of operating with two flight crewmembers and up to 16 passengers.

The Bombardier Model BD-100-1A10 airplane will incorporate an unusual design feature to show compliance with the approach climb requirements of § 25.121(d) ("Climb: One-engine-inoperative"). This design feature is the Automatic Takeoff Thrust Control System (ATTCS). Appendix I to Title 14, Code of Federal Regulations (CFR), part 25, limits the application of performance credit for ATTCS to takeoff. Since the airworthiness regulations do not contain appropriate safety standards for approach climb performance using ATTCS, special conditions are required to ensure a level of safety equivalent to that established in the regulations.

Type Certification Basis

Under the provisions of § 21.17, Bombardier must show that Bombardier Model BD-100-1A10 meets the applicable provisions of 14 CFR part 25, effective February 1, 1965, including amendments 25-1 through 25-98.

If the Administrator finds that the applicable airworthiness regulations (*i.e.*, part 25, as amended) do not contain adequate or appropriate safety standards for the Bombardier Model BD-100-1A10 airplane because of novel or unusual design features, special conditions are prescribed under the provisions of § 21.16.

The certification basis also may include later amendments to part 25 that are not relevant to these special conditions. In addition, the certification basis for the Bombardier Model BD-100-1A10 airplane includes the following:

- 14 CFR part 34, effective September 10, 1990, including amendment 34, effective February 3, 1999, and
- 14 CFR part 36, effective December 1, 1969, including amendments 36-1 through 36-23 or through 36-24, as elected by the applicant.

These special conditions form an additional part of the type certification basis. The certification basis also may

include other special conditions that are not relevant to these specific special conditions.

If the Administrator finds that the applicable airworthiness regulations (in this case, part 25) do not contain adequate or appropriate safety standards for the Bombardier Model because of a novel or unusual design feature, the FAA may prescribe special conditions under the provisions of § 21.16 ("Special conditions"). The special conditions become part of the type certification basis in accordance with § 21.101(b)(2) ("Designation of applicable regulations").

Special conditions are initially applicable to the model for which they are issued. Should the type certificate for that model be amended later to include any other model that incorporates the same novel or unusual design feature or should any other model already included on the same type certificate be modified to incorporate the same novel or unusual design feature, the special conditions would also apply to the other model under the provisions of § 21.101(a)(1).

Novel or Unusual Design Features

As stated previously, the Bombardier Model BD-100-1A10 airplane will incorporate an unusual design feature—ATTCS—to show compliance with the approach climb requirements of § 25.121(d). This airplane is powered by two Allied Signal turbofan engines mounted on the aft fuselage and equipped with Full Authority Digital Engine Controls (FADEC) that, in part, protect against exceeding engine limits.

The airplane also incorporates a non-moving throttle system that functions by placing the throttle levers in detents for the takeoff and climb phases of flight or for a go-around; this throttle system allows the FADEC to schedule the power setting, based on the phase of flight. With the ATTCS and associated systems functioning as designed, all applicable requirements of part 25 will be met without requiring any action by the flight crew to increase power.

Automatic takeoff power control on the Bombardier Model BD-100-1A10 airplane involves uptrimming the operating engine to maximum takeoff power. This action will be controlled by the FADEC. At takeoff, when the power levers are set to the Takeoff Go-Around (TOGA) detent, if there are no FADEC fault or failure messages displayed, the system is armed, and ATTCS uptrim will occur without any further action by the crew if an engine fails. During a go-around, the uptrim is automatically armed.

For a go-around, the thrust levers are placed in the TOGA detent. The value of TOGA for the current ambient conditions will be calculated and set by the FADEC. If an engine fails, the ATTCS will change the power reference on the operating engine to achieve the maximum go-around power for the ambient conditions. The propulsive thrust used to determine compliance with the approach climb requirements of § 25.121(d) is limited to the lesser of (i) the thrust provided by the ATTCS system, and (ii) 111 percent of the thrust resulting from the initial thrust setting with the ATTCS system failing to perform its uptrim function and without action by the crew to reset thrust. This requirement serves to limit the performance effects of an ATTCS system failure and ensures that all-engines-operating go-around performance is not significantly degraded.

The engine operating limits (turbine temperature and N1) for TOGA are set and displayed to the pilot when that rating is selected. These limits are set in such a way that the engine redline limits are not exceeded when an ATTCS is engaged. When the maximum takeoff power rating is selected or triggered, the engine limits are reset automatically to reflect the uptrimmed engine redline limits.

The system is armed during all phases of the flight. The power levers will continue to function normally if the ATTCS should fail. Maximum takeoff/go-around power is available if the pilot elects to push the power levers past the takeoff/go-around power detent into the overtravel range.

Operations of all systems and equipment will be designed to function within the engine power range. Thrust increase from the initial to the maximum approved takeoff/go-around power level will be free of hazardous engine response characteristics.

The ATTCS function, as described above, is part of the powerplant control system. The ATTCS is always armed whenever power levers are above the idle detent. The system is verified before each flight via the FADEC built-in test feature. When the ATTCS is triggered following an engine failure, an "APR" message will appear on the engine display.

The FADEC installed on the Bombardier Model BD-100-1A10 airplane will ensure that inherent flight characteristics of the airplane do provide adequate warning, if an engine failure occurs during takeoff. The natural yawing tendency of the airplane, coupled with flashing master warning and master caution lights, will provide